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CURRENT STATUS THE BEARINGS OF URANIUM ORES IN THE SLOVAK REPUBLIC

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Abstract

At the mining over many centuries the mineral reserves especially of metallurgical and precious metals in Slovakia have exhausted. Their residues are now only mineralogical significance. The exceptions are bearings of uranium ore, where extensive geological surveys and smaller mining began on the Slovakia until in the year 1948 in the Novoveská Huta. In the last decade last century, the mining in the context attenuation of the mining industry was stopped. The bearings of uranium ore are occur in the arc of the Central Carpathians in the rocks of the Paleozoic - Permian from the Nové Mesto nad Váhom after the South Zemplín (Rojkovič 1997). About the ore of uranium on the Slovakia they have interested foreign companies and most of the exploration licenses is under the control of the companies from Canada and Australia, which exploring the bearings of uranium ore since 2005. The expanse of exploration areas is today more than 300 km^2. The exploration of the uranium bearings met resistance of the local governments and citizens of the concerned areas. They fear that foreign investors do not enter into exploration projects only from the aspect of mapping geological reserves of uranium ore and do not intend uranium mine. Aim of this paper is to give a characteristic of selected bearings of uranium and point out environmental and functional and spatial implications eventual mining of uranium ore.

Key words: *Bearings of Uranium Ore, Slovak Republic, exploration of Uranium Ores, Negative Consequences of Mining Uranium Ores on the Environment*

1. INTRODUCTION

In this paper we deal with two most significant bearings of uranium ore in the eastern Slovakia. Both bearings according to recent geological surveys by foreign companies (2005 - 2012) are significant not only in the Slovakia. They are bearings the Novoveska Huta (local part of the city Spišská Nová Ves) and bearing Čermeľ - Jahodná (elevation Kurišková) near the city of Košice. From the aspect of geological-tectonic structures are both bearings part of the Northgemeric Syncline (in the tectonic unit Gemericum, Maheľ 1989) and belong in to the geomorphological area of Slovenské rudohorie (the Slovakian Ore Mountains, Mazúr, Lukniš 1986). The bearings of uranium ore are found in the Permian of West Carpathians in the Krompachy group in the formation of Petrovohorská unit (Maheľ 1986, Novotný, Mihál' 1987).

Novoveská Huta. The strata of Petrovohorská unit are here characterized by the predominant proportion of volcaniclastic rocks. Searching of uranium ore in the bearing took place in the years 1947 -1957 and probationary extraction in 1954, 1956 and 1957. In the years 1964-1968 there were in the quarry on the hill Malý Muráň experimental surface - extraction and in underground in Novoveska Huta (ore U - Mo). In the Novoveska Huta are the bearings in two positions above each other with a distance of 200 m apart. The lower bearing has a length of 4 km, width from 200 to 600 m and the thickness is several tens of meters. Bearing has a triangular shape. From 1962 to 1990 here were traditional felling 133 170 kg of uranium class A and 152 589 kg uranium classes A + S (S is uneconomic class). In year 1990 the mining was stopped (Daniel 2005). All data on the geological exploration and data of the extraction were evaluated and formed a basal material for geological surveys from years 2006 - 2012 carried out by the Ludovika Energy Ltd. (a subsidiary of European Uranium Resources Ltd.).

Second very important bearing is located near the city part the Košice - I (west) the Čermeľ-Jahodná (on the hill Kurišková). Bearing is located in the eastern part in the Permian of North Gemeric in the strata of Petrovohorská unit (Mihál' et al. 1996). In the geological structure here dominated the complex of volcano-sedimentary rocks, which were the subject of exploration on the surface as well as by means of the boreholes. Compared with Novoveská Huta, where is a transitional zone of Permian, but on the Kurišková is the central zone development of Permian (Rojkovič, Novotný 1993, Rojlovič 1997). Dispersed uranium mineralization here binds on the layers

from meta-tuffs in the overburden of andesites (Baláž 2010, Novotný 2012). In year 2009 was found and verified in the northern part of the ore bearing new position U - Mo ores, about 50 to 120 m above the main ore horizon. The bearing at the Kosice – hill Kurišková is one of the most valuable in the world (Daniel, Mesarčík 2008). The survey was carried out even here by Ludovika Energy Ltd. (the subsidiary of European Uranium Resources Ltd.). Even in this case the company followed on the project the Uranium survey of the race IX in Spišská Nová Ves in 1996, which was financed from the state budget.

2. THE RESULTS OF GEOLOGICAL EXPLORATION OF URANIUM ORES

Until 1989, the exploration and production of uranium ore in Slovakia was not possible to obtain any materials. All these activities were top secret. At present, this material is available and it is possible to have an overview of all processes that affect this area. From 1947 to 1960 surveys in deposits of uranium ore in Slovakia in Novoveska Huta (where uranium was mined) made Jáchymov mine workers from the Czech Republic (Daniel, Mesarčík 2008).

Table1 Reserves and production data of uranium ores in the Slovak Republic 1997-2010

Year	1997 - 2002	2003 – 2004	2005 - 2010
Total Number of deposits	4	2	2
of which exploited	0	0	0
Reserves total [t U]	8 051	6 796	10 049
economic (Z -3)	5 269	5 296-	6 561
potentially economic	2 782	1 527	3 488
Mining output[t U]	0	0	0

Source: Baláž et al. 2000, Baláž et al. 2004, Baláž 2007, Baláž, Kúšik 2011

Only in 1960 was established in Slovakia independent enterprise Uranium survey š. p. IX race in Spišská Nová Ves (Daniel 2005). Throughout the history of uranium mining and exploration made more than 59 mineshafts and the same number manholes. In Czechoslovakia was created sole a surface quarry for the extraction of uranium ore south from the Novoveská Huta on the hill Malý Muráň.

Table 2. Reserves and Production data Novoveská Huta by Spišská Nová Ves

(Exploration, Ludovika Energy Ltd.) 2006 – 2011

Reserves Novoveská Huta	Ore	Average content U and U_3O_8		Reserves in [t] U and U_3O_8	
	kt	% U	%U308	U	U_3O_8
Economic (Z1 +Z2)	1 662	0.0865	0.1025	1 440	1 700
Economic Z3	4 689	0.104	0.123	4 900	5 780
Total	6351	-	-	6 340	7 480

Source: Novotný et al. 1012

Table 4. Reserves of Mo deposits, Novoveská Huta by Spišská Nová Ves

(Exploration, Ludovika Energy Ltd.) 2006 – 2011

Reserves Novoveská Huta	Ore in [kt]	Average content %Mo	Reserves Mo in [t]
Economic Z3	4 689	0.021	1 310

Source: Novotný et al. 2012

The centre of uranium mining was Novoveská Huta (which is one part of the city Spišská Vová Ves), where has been most exploration works. Mining works were also made in the area from Spišský Stvrtok after Vikartovce with the bearings of uranium ore by the Spišský Štiavnik, Švábovce, Kravany and Vikartovce (Rojkovič 1997, Rojkovič, Novotný, Háber 1993). In the Slovakia was not processing industry for uranium ore. The whole mining was sent to the Ukraine, to the Estonia and into the Czech Republic to finishing enterprises (Daniel 1999). Mining of uranium ores has its own specifics. The radioactive material is present in the all the heaps, include it in the water areas of occurrence and ore mining. This material emits a certain amount of radioactivity that is detrimental to the environment. In order to eliminate effects of radioactivity on the environment was created the project of the European Commission PHARE (1999-2000). The main solvers the project has been company Koral, Ltd. and URANPRES, Ltd. Spišská Nová Ves. The other projects these both companies (2006 - 2012) include the drilling operations on search U - Mo ores and monitoring of gamma radiation on the localities Novoveská Huta and Košice I - Jahodná Kurišková.

Table 3. Reserves of Uranium deposits, Košice I – Kurišková (Exploration, Ludovika Energy Ltd.) 2006 – 2011

Reserves Kurišková	Ore	Average content		Reserves in [t]	
	[kt]	% U	% U_3O_8	U	U_3O_8
Economic Z2	2 328	0.471	0.555	10 957	12 921
Economic Z3	3 099	0.185	0.185	4 871	5 744
Total	6 351			15 829	18 666

Source: Novotný et al. 1012

Table 5. Reserves of Mo, deposits, Košice I - Kurišková (Exploration, Ludovika Energy Ltd.) 2006 – 2011

Reserves Kurišková	Ore	Average content	Reserves in [t]
	[kt]	% Mo	Mo
Economic Z2	2 301	0.065	1 502
Economic Z3	2 996	0.033	991
Total	5 297	-	2 493

Source: Novotný et al. 2012

The foreign companies and uranium lobby in the Slovak Republic, as well as the Ministry of Environment the Slovak Republic explains the uranium ore exploration and its prospective mining by ensuring a kind of energy independence of Slovakia. That argument is irrelevant. The Slovak Republic does not have the equipment for the enrichment of uranium as well as technologies that are necessary to produce nuclear fuel for nuclear power plants. The Slovak Republic is 100% dependent on imported fuel for its nuclear power plants and it is related in particular with the type of nuclear reactors (the Voronezh - type) in our power stations. It follows that the mining of our bearings of uranium ore from this aspects for the Slovak Republic at present time is not advantageous. It is necessary to preserve them for future generations. The foreign companies have particularly interested to apply this commodity in foreign markets. The spot price of uranium was in 2007 138 USD per pound (0.45 kg). After the Fukushima disaster are decreased. In year 2009 the average price decreased to 46 USD per pound (U_3O_8) in year 2010 reaching average of 61 USD per pound. Today is around 35.5 USD per pound. It is a price below the cost of mining. It is anticipated that in 2014, the price of uranium will grow in connection with the renewal of the nuclear program in many countries (for example, China has in the construction of 28 nuclear reactors 5 of them should be attached as early as this year, Japan intends to put into operation 17 nuclear reactors, etc.). The price of uranium U_3O_8 70-80 USD per pound assumes renewal of mining operations in locations which have been after Fukushima accident closed what lowered the price of uranium (Bogner, 2014 Rockstone Research).

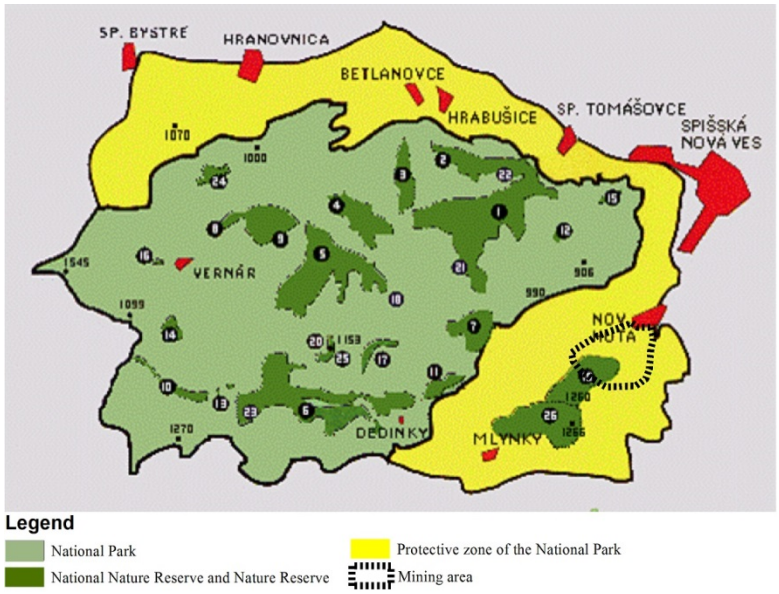


Fig.1. National Park Slovenský raj and Mining area of uranium

3. ENVIRONMENTAL ASPECTS IN RELATION TO THE POSITION OF THE BEARINGS OF URANIUM ORE

Administrative are both deposits of uranium ore Kuríškova - Jahodná and Novoveská Huta to the Selfgovernment Region of Kosice in the district Košice I and Spišská Nová Ves. On the territory of Selfgovernment Region of Košice there were a total of 791 723 inhabitants, which is 14.7% of total inhabitans of the Slovak republic. By number of inhabitants is the second largest in the Slovak Republic. It belongs into the denser populated regions. The average population density is 117.6 inhabitants per km^2. It is 7.3 inhabitants more than the average for the Slovak Republic. The most densely-populated are four districts which are located in Košice city. In the regional city the Kosice live 240 433 inhabitants, which is 30.4% of the population of the region. The city of Košice is in the Slovak Republic the second largest conurbation after the capital city Bratislava. It is a metropolis of Eastern Slovakia. In September 2008 the city of Košice the first city in the Slovak Republic awarded the prestigious title of "European Capital of Culture". The bearings of uranium are located in the district of Košice I (the bearing not protruding on the surface but begins at a depth of around 150-200 meters below the surface and continues to a depth of 800 meters). In the district of Košice I lives 68 467 inhabitants (the second highest population of the districts of the Košice city). The population density is here 786 inhabitants per km^2. The bearings of uranium ore in Kosice I are from the aspect of functional and spatial relationships in a suburban recreational area Čermeľ-Jahodná and in the suburban forest park Kosice Bankov (Leštáková 2012) wherein forms a substantial part the Kosice Forest, significant bio-centres with an area of more than 1600 ha (Košice city acceded to the procurement of a validation study of suburban park Kosice-Bankov within the international project PERIURBAN). In a suburban park has a variety of bio-centres and bio-corridors which are of supra-regional importance. The area is significant from aspect of the floristic terms. There are meadows with the occurrence of hygrophilous flora. Of particular note are relict species of the Orchid family (*Dactylorhiza majalis Dactylorhiza incarnata*, *Dactylorhiza* etc.). Valuable part the area are forest associations the fir and beech (*Abieto-Fagetum*) and associations from union oak-hornbeam forests of the Carpathian (*Carici pilosae-Carpinenion betuli*). Here is located sports-recreation resort of Jahodná (hotels, restaurants, ski areas, swimming pool, golf course etc.) and also a cottage settlement. The areal Jahodná has an old tradition. Represent the popular recreation and tours area not only for inhabitant of Košice city. Nearly by is Košice Zoo. Addition to these structures here is a source of drinking water (at the end Čermeľ valley) and its zone of protection. For supplying the city are used already of 100 years. The protection zone of drinking water passes across protected deposit area of uranium (..the question is what was the first? Answer recreation resort). Bearings of uranium ores on Kurišková is at a distance of 7 km WNW from the border of the city Košice in forested terrain in the geomorphological unit Volovské vrchy (Mountains) of 600 m above sea level, only one km from the sports and recreation zone of Jahodná. Ministry of Environment of the Slovak Republic declared 16. 04. 2010 in this space the Special Protected Areas (The Bird Direction EU, Natura 2000), with an extent of 121 420, 65 ha. Importance of protected areas is in keeping the gene pool habitats of rare species bird that nest in cavities in the Carpathian

Mountains. It is a site of Community importance (Europe). Significant is here the locality Kamenný hrb where of the gene pools of the bird species are nesting *Glaucidum passerinum, Strix uralensis, Aegolius, Picoides tridactylus, Dryocopus Woodpecker, Picus canus, Dentrocopus minor, Dentrocopus leucotos, Dendrocopus medius, Regulus ignicapillus* and other species.

Novoveská Huta is located in the protection zone of the National park "Slovenský raj" in the height of 560 m on the sea level. It was the only one bearing of uranium ore in the Slovak Republik where the uranium mined not only in the underground, but also on the surface in the quarry on the hill Veľký Muraň. The bearings of uranium and molybdenum ores is located directly under the municipal part of the district of Spišská Nová Ves city in the Novoveská Huta, which is 6 km south of the centre of the district city. As at 31 12 2012 had Spišská Nová Ves Ves 37,767 inhabitants and the whole district 98,244 inhabitants. The city has more than one third of the population of the district. The population density is 167 inhabitants per km^2. Spišská Nová Ves is located at the contact zone of the Hornádska kotlina (basin), Volovské vrchy (Mts.) and Spišsko-gemerský kras (Michaeli 2008, territory of karst region). The city is entrance gateway to the National Park "Slovenský raj". Cadastral territory of Novoveská Huta is situated in the protection zone of National Park "Slovenský raj" one of the most valuable areas of the Western Carpathians (Fig.1). It is wealthy on occurrence the species and habitats. Its area is 197.63 km ², protective zone have 130.11 km ². For its exceptional values Slovak Paradise was classified as specific area of Conservation network of NATURA 2000.

There are here more than 950 species of vascular plants, of which 85 species is listed in the national Red List. There live 72 kinds of animals of European importance and 122 species of national importance and over 2 000 species of butterflies and 18 species of bats. Represented here are all large carnivores of Carpathians - *Ursus arctos*, *Canis lupus* and *lynx Lynx*. High biodiversity represents integrated complexes of forest, rock, grassland and wetland habitats, including the 27 habitats of European importance and 8 habitats of national importance. There are 11 National nature reserve and 8 Nature Reserve, 300 km of hiking trails and about 350 caves, of which the Dobšinská ľadová jaskyňa (ice cave) is since of 2000 in a World Heritage site UNESCO. These areas represent the most valuable natural heritage that we have in Europe. Their inclusion in the Natura 2000 network ensures the protection of habitats and plant and animal species listed in the EU Habitats Directive, which is one of the most significant legislative frameworks for nature conservation in the EU. According to environmental regionalization of the Slovak Republic (Bohus, Klinda 2010) include the territory bearings of uranium ores Košice I - Kurišková into the third degree environmental quality, dusturbet environment and strongly disturbed with the exception of a small part of the district Košice I, which are represents suburban recreation area, part of the City park Kosice - Bankov and it is a component of the Protected Bird Area - Volovské vrchy (Mts.) of European importance with the valuable biotopes. The area of environmental load in Košice does not include the part of the district Košice I (Bohuš Dzugasová 2011). Precisely in this environmentally valuable zone with the least disturbed natural structure which the only one providing the inhabitants the Aglomeration of Košice the possibilities relaxation are uranium deposits.Space of the bearing Novoveská Huta has second degree of environmental quality, satisfactory environment and moderately disturbed (Bohuš, Dzugasová 2011).

4. SUPPOSED IMPACT OF URANIUM MINING ON THE ENVIRONMENT IN BOTH LOCALITIES

The spatial position of both deposits of uranium ore from the aspect of their possible mining is controversial and unique even within the European context. Uranium mining on the bearing Košice I Jahodná - Kurišková from the functional and spatial and environmental aspects is inappropriate:

- Will jeopardize the health of the population the second largest agglomeration (after Capital) in the Slovak Republic with more than 240,000 inhabitants. The city is just 7 km away from bearings of uranium. Nowhere in the world does not the mining of uranium ore near by the larger agglomerations,

- Will be degradation of suburban recreation zone,

- Will be contaminated an important source of drinking water, which inhabitants of Košice city utilize over 100 years and surface waters,

- Will jeopardize and irreversibly will damage the Special Protected Areas (The Bird Protected Area) with the biotopes of European importance,

- Reduces the size of area of forest associations of special purpose and will damage the natural habitats of wet meadows with rare species of orchid and other flora,

- Will jeopardize existence of the city park,

- Will cause extreme fragmentation of the landscapes and consequently will destabilize the nature habitats and will cause the isolation of populations, eliminating the exchange of genetic information of all species,

- Will disturb significantly the ecological stability of the landscape,

- Will bring of minimum of working posts,

- Uranium is ore from which it can use only a small part (1 000 kg of ore/500 g uranium), the rest is radioactive waste. Petition against of uranium mining signed by more than 100 000 citizens and 40 towns and villages,

- Most of inhabitants of Kosice are definitely against uranium mining. The City Council has decided on 16. 09. 2013 on a proposal of Members banning uranium mining on the site Jahodná - Kurišková. This decision is not valid. It is contrary to the law of construction and mining.

The uranium mining on the locality of Novoveská Huta is against the law of nature and landscape protection and destroyed the natural landscape structure area and will have influence on health of inhabitant:

- Located is under the urban district Novoveská Huta in the district the city Spišská Nová Ves in which live more than one third of the population of the district,

- Spišská Nová Ves is the gateway to the National Park Slovenský raj,

- Cadastral territory of Novoveská Huta is a part of the protected zone of the National Park Slovenský raj,

- Near the Novoveská Huta in protected zone of National Park Slovenský raj is Natural Reserve Muráň,

- National park Slovenský raj is also a Protected Bird Area,

- National park Slovenský raj is one of the most valuable area of the Western Carpathians. For its exceptional value has been classified as European territory Special Areas of Conservation of Natura 2000,

- On a decision of Main Mining Office in Banská Štiavnica has been determined mining area extraction of uranium ore in the deposit Novoveská Huta status on the date 31. 12. 2012,

- Uranium mining in the Novoveská Huta is contrary with plan construction of recreational area "Spišský raj,"

- Uranium mining in the protected zone of the National Park is nowhere in the world. Certainly occurs here to the conflicts of interest nature and landscape protection under the Act of the National Council of the Slovak Republic, Act on Nature and Landscape Protection No. 534/2002 Coll. and Mining Act, The Act on the Protection and Use of Mineral Resources No. 558/2001 Coll.

5. CONCLUSIONS

Everywhere in the world, after extraction of uranium shall remain the unquantifiable damage, degraded ecosystems, contaminated water sources, weakened immunity the inhabitant, and a high incidence of carcinogenic of diseases. Uranium mining is profitable only mining companies. On the inhabitants in the region of mining has an adverse impact. Guarantee the safety of uranium mining is impossible. Reserved deposits of uranium in Kosice I Jahodná - Kurišková are under the Mining Act, The Act on the Protection and Use of Mineral Resources No. 558/2001 Coll. the protected deposit area because they are in a state geological exploration. At the Ministry of the Environment SR despite the protests of citizens and nongovernmental organizations was prolonged exploration period for Company Ludovica - Energy on the locality of Jahodná - Kurišková to 19. 04. 2015 m. Exploration is underway for 8 years. Preferential right to determine the mining area has an organization that has the specified territory for exploration and it performs at its own expense. Preferential right may be exercised by the application to the determination of the extraction area within six months after assessment and approval of the final report containing the calculation of reserves bearing by geological survey. On protected deposit area in Novoveska Huta was mining area Main Mining Office in Banská Štiavnica intended.

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